Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Streamlining Licensing Procedures for Small Satellites	)	IB Docket No. 18-86
	)	
	)	

To: The Commission

COMMENTS OF
THE BOEING COMPANY

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SUMMARY

The growing use of relatively small satellites to support commercial activities in space necessitates that the Commission create a streamlined licensing process for these systems. At the same time, the Commission must preserve the availability of its experimental licensing process for satellites that are not used for commercial purposes, including experimental satellites that are used for the various activities that are specified in Section 5.3 of the experimental licensing rules.

The defining characteristic of small satellites that are used for commercial purposes (referred to herein as "Small Commercial Satellites") should be the nature of their orbital and spectrum sharing rights and obligations. To the extent technically feasible, all Small Commercial Satellites should be required to share spectrum and orbital resources will all existing and future Small Commercial Satellites, with no rights of incumbency, or heightened obligations for new entrants. Granted, practical limits exist on the operational adjustments that can be made to a small satellite once it has been launched. For this reason, the obligation to share orbital and spectrum resources with future Small Commercial Satellites should be limited to what is technically feasible. In contrast, the *NPRM* proposal that Small Commercial Satellites not "unreasonably preclude" future operators may impose little or no practical obligation on incumbent operators of Small Commercial Satellites.

The orbital and spectrum sharing rights and obligations of Small Commercial Satellites should also extend to their relationship with other authorized spectrum users. Specifically, Small Commercial Satellites should be required both to protect the operations of, and accept harmful interference from, all existing and future non-streamlined Part 25 satellite licensees. At the same time, Small Commercial Satellites operating in frequency bands that are allocated on a co-primary basis to an NGSO satellite service should be subject to the same interference protection obligations,

and enjoy the same interference protection expectations, that exist for non-streamlined Part 25 satellite licensees with respect to other services operating in those frequencies. Finally, Small Commercial Satellites operating in frequency bands that are not allocated on a primary or co-primary basis to a non-streamlined Part 25 NGSO satellite service should be required to operate in that spectrum on an unprotected, non-harmful interference basis, just like an experimental licensee.

Consistent with these obligations to share spectrum and orbital resources with other authorized users, the Commission should not impose a bond requirement on Small Commercial Satellites. The Commission's bond requirement is intended to prevent warehousing of spectrum and orbital resources. Small Commercial Satellites do not present risks of speculation or warehousing because they do not prevent the use of the same spectrum or orbital resources by other Commission licensees.

The Commission should also refrain from adopting many other constraints on Small Commercial Satellites that qualify for streamlined processing. Although some limit on the total number of satellites covered by a license may be appropriate, the Commission should consider increasing that number to a presumption of 30, which would align with the proposed application processing fee of $30,000. Boeing agrees with the Commission's proposal to limit the license term of Small Commercial Satellites to five years for both the mission life and deorbit. The Commission, however, should not impose a potentially arbitrary limit on spacecraft size or mass, or on the bandwidth requested for Small Commercial Satellites. Instead, licensees will have ever economic incentive to keep their satellites as small and inexpensive as possible. Boeing also concurs with the Commission on many of its other regulatory proposals for Small Commercial Satellites, with certain modifications to preserve flexibility for these innovative spacecraft.

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The Boeing Company ("Boeing") strongly supports the Commission's proposal to create a new streamlined licensing process for small satellites that are used for commercial purposes. Boeing and other satellite operators and manufacturers use small satellites for a growing range of productive activities. In Boeing's case, nearly all of these activities are experimental in nature, supporting research and testing of new satellite components, technologies and operational techniques, and providing a zero gravity test environment for non-satellite experimentation.

Boeing recognizes, however, that satellite operators and manufacturers are increasingly using small satellites for commercial endeavors, such as Earth sensing and low data rate transmissions to support the Internet-of-things. The competitive business case for many of these activities could not survive the significant costs of the Commission's application processing fee or the expenses of preparing and prosecuting an NGSO system license pursuant to Sections 25.114 and 25.157 of the rules. Therefore, to the extent that the Commission concludes that commercial activities involving small satellites do not qualify for experimental licenses, it is appropriate – and in fact necessary – to create a new streamlined licensing regime for small satellites that are used for commercial purposes, or, as referenced herein "Small Commercial Satellites."

I. THE NEW LICENSING FRAMEWORK FOR SMALL COMMERCIAL SATELLITES SHOULD SUPPLEMENT, AND IN NO WAY REPLACE, THE EXISTING AUTHORIZATION PROCESS FOR EXPERIMENTAL SATELLITES

Although Boeing supports the creation of a streamlined licensing regime for Small Commercial Satellites, Boeing urges the Commission to confirm that the existing authorization process under Part 5 of the Commission's rules will continue to be available to support research and development activities involving experimental satellites. Continued access to experimental licenses remains necessary both to support the public sector – including, for example, universities and research institutions – and the private sector, including satellite manufacturers large and small.

Many of the experiments that are conducted using small satellites cannot be replicated fully – or reliably – in laboratories on the Earth's surface. On-orbit component failures are often attributed to unforeseen conditions or coupling of effects that cannot be adequately tested until the components are exposed to an orbital environment. Consequently, the use of an on-orbit test bed provides significant direct and indirect financial benefits and risk reduction for future satellite programs and for public safety. In addition, on-orbit test data provides confidence to potential customers that future products will operate successfully on-orbit at the required specifications.

Given the ongoing importance of the Commission's experimental authorization process for satellites, the Commission should continue to make this process available for each of the purposes described in Section 5.3 of its rules, including for radio research; communications essential to research; technical demonstrations of equipment or techniques, including to potential purchasers or in advance of production; product development and marketing trials, and experiments under

contract with the U.S. government.[1] Each of these activities provide important public interest benefits and should not be supplanted by an authorization process for commercial satellites.

II. THE PRIMARY DEFINING CHARACTERISTIC OF SMALL COMMERCIAL SATELLITES SHOULD BE THE NATURE OF THEIR ORBITAL AND SPECTRUM SHARING RIGHTS AND OBLIGATIONS

The *NPRM* appears to struggle with the threshold question of how to characterize and define a category of spacecraft that would qualify as Small Commercial Satellites. Boeing fully sympathizes with this, having participated in many discussions on this subject within satellite industry associations and during meetings and conferences of the International Telecommunication Union ("ITU").

Boeing recommends that Small Commercial Satellites be defined by a single controlling characteristic, the nature of their orbital and spectrum sharing rights and obligations. As the *NPRM* observes, "the ability to share spectrum with existing and future operators in a particular frequency band, will differentiate small satellite systems under consideration in the *Notice* from typical NGSO FSS, MSS, or other systems requiring full-time uninterrupted availability of assigned spectrum."[2]

Consistent with this, to the extent technically feasible, all Small Commercial Satellites that are authorized under the Commission's streamlined licensing process should be required to share spectrum and orbital resources will all existing and future Small Commercial Satellites. There should be no rights of incumbency, or heightened obligations for new entrants. Instead, the rights of each Small Commercial Satellite licensee should be equal and effectively comparable to the

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[1] *See* 47 C.F.R. § 5.3.

[2] *NPRM*, ¶ 4; *see also id*, ¶ 26 (noting the ability of small satellites "to share and not preclude other operations in a particular frequency band").

spectrum sharing rights and obligations of the participants in an NGSO processing round – each required to work with all of the other applicants in that processing round to identify ways to share spectrum and orbital resources between them.

In advocating for this orbital and spectrum sharing approach, Boeing acknowledges that practical limits do exist with respect to the adjustments that can be made to an NGSO constellation of small satellites once they have been launched. For this reason, Boeing proposes the inclusion of a "technically feasible" requirement. Thus, once a Small Commercial Satellite has been launched, its operator cannot be expected to make changes that are not technically feasible, such as significant adjustments to its orbit or significant changes to the frequency bands employed while on orbit. In contrast, numerous other changes can be made, some of which are identified in the *NPRM*, including limiting transmissions to certain times of the day, limiting earth stations operating with the system to certain defined geographic locations, and installing directional antennas on ground stations.[3] Although certain of these changes may result in financial expense for an incumbent operator of a Small Commercial Satellite or reduce the data throughput of its network, such changes should be required if necessary to facilitate sharing of scarce orbital and spectrum resources with other Small Commercial Satellites.

In contrast, the *NPRM* proposes that operators of Small Commercial Satellites should only be obligated to not "unreasonably preclude" future operators from using assigned frequency bands.[4] Boeing is concerned that an "unreasonable preclusion" standard may impose little or no

[3] *See id.*, ¶ 43.

[4] *Id.* Boeing assumes that the Commission intended to reference both spectrum *and* orbital resources in its proposed certification requirement and, if the Commission does adopt its proposed certification requirement – which Boeing does not support in its current form – then the certification should apply to both spectrum and orbital resources.

practical obligation on incumbent operators of Small Commercial Satellites. Licensees of non-streamlined NGSO systems are arguably subject to a higher standard of sharing than "unreasonable preclusion" in that they are required by the Commission "to discuss their technical operations in good faith with an aim to accommodating both systems."[5] The ITU has employed similar guidance, explaining that "no administration obtains any particular priority as a result of being the first to start either the advance publication phase (Section I of Article 9) or the request for coordination procedure (Section II of Article 9)."[6]

At the very least, licensees of Small Commercial Satellites should be subject to these same obligations. Boeing believes, however, that the more appropriate approach is one that recognizes the highly flexible and temporary nature of Small Commercial Satellites. Specifically, the licensees of such systems should be required, to the extent technically feasible, to share orbital and spectrum resources with all existing and future Small Commercial Satellites.

III. SMALL COMMERCIAL SATELLITES SHOULD ALSO HAVE CLEARLY DEFINED ORBITAL AND SPECTRUM SHARING RIGHTS AND OBLIGATIONS WITH RESPECT TO OTHER AUTHORIZED SPECTRUM USES

The defining characteristic of Small Commercial Satellites should not be limited to their spectrum sharing rights and obligations with respect to other Small Commercial Satellites. The rights and obligations of these systems should extend to their operations in frequency bands that are shared with non-streamlined satellite systems and with non-satellite federal and non-federal spectrum uses.

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[5] *See* Update to Parts 2 and 25 Concerning Non-Geostationary, Fixed-Satellite Service Systems and Related Matters, *Report and Order and Further Notice of Proposed Rulemaking*, 32 FCC Rcd 7809, ¶ 48 (2017) ("*NGSO FSS Sharing Order*").

[6] ITU-R Rules of Procedure, Part A1, AR9, at 3 (2017) (interpreting Radio Regulation 9.6).

First, each Small Commercial Satellite licensee operating in a band allocated to a non-streamlined Part 25 satellite service should be required both to protect the operations of, and accept harmful interference from, all existing and future non-streamlined Part 25 satellite licensees, including operators of GSO and NGSO, FSS, MSS, and EESS satellite systems. This is necessary to reinforce the subordinate status of Small Commercial Satellites as compared to non-streamlined satellite systems.

Second, each Small Commercial Satellite licensee operating in a band that is allocated on a co-primary basis to both an NGSO satellite service (be it FSS, MSS, or EESS) and to another service (be it GSO satellite or non-satellite) should be subject to the same interference protection obligations, and enjoy the same interference protection expectations, that exist for non-streamlined Part 25 satellite licensees with respect to spectrum sharing with federal and non-federal services operating in those frequencies. This requirement is consistent with the reasonable expectations of other spectrum users with respect to the level of interference protection they receive from NGSO satellite services. At the same time, operators of Small Commercial Satellites should be entitled to the same interference protections that exist for non-streamlined NGSO satellite systems in a band that is shared on a co-primary basis with other spectrum uses.

Third, each Small Commercial Satellite licensee operating in a band that is not allocated on a primary or co-primary basis to a non-streamlined Part 25 NGSO satellite service should be required to operate in that spectrum on an unprotected, non-harmful interference basis, just like an experimental licensee. This treatment is appropriate given the fact that the Small Commercial Satellite would be operating in a manner that is inconsistent with the Commission's Table of Frequency Allocations.

If the licensee of a Small Commercial Satellite system cannot operate or maintain its chosen business case within these explicit constraints (including the requirement that all Small Commercial Satellites share orbital and spectrum resources with all existing and future Small Commercial Satellites), then the licensee should apply for a non-streamlined NGSO satellite license using the existing processes pursuant to Sections 25.114 and 25.157.

IV. THE COMMISSION SHOULD NOT IMPOSE A BOND REQUIREMENT ON SMALL COMMERCIAL SATELLITES

The Commission imposes a bond requirement on non-streamlined satellite licensees to "prevent harmful 'warehousing' of spectrum and orbital resources."[7] As the Commission explained, "requiring satellite licensees to make a financial commitment to construct and launch their satellites would help deter speculative satellite applications."[8]

Small Commercial Satellites, however, do not present risks of speculation or warehousing of spectrum and orbital resources because they do not prevent the use of the same spectrum or orbital resources by other Commission licensees. Again, as the Commission acknowledged in its *NPRM*, the differentiating characteristic of Small Commercial Satellites is their "ability to share spectrum with existing and future operators in a particular frequency band."[9]

Further, a bond requirement is unnecessary to motivate licensees of Small Commercial Satellites to launch their proposed systems as quickly as possible. No speculative benefits can

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[7] *NGSO FSS Sharing Order*, ¶ 62.

[8] Amendment of the Commission's Space Station Licensing Rules and Policies, *First Order on Reconsideration and Fifth Report and Order*, IB Docket No. 02-34, FCC 04-147, ¶ 5 (July 6, 2004); Amendment of the Commission's Space Station Licensing Rules and Policies, *First Report and Order*, IB Docket No. 02-34, 18 FCC Rcd 10760, 10825, ¶ 167 (2003).

[9] *NPRM*, ¶ 4; *see also id*, ¶ 26 (noting the ability of small satellites "to share and not preclude other operations in a particular frequency band").

accrue from delaying the launch of a Small Commercial Satellite. In contrast, launching expeditiously can provide modest benefits to a licensee in that, following launch, their spectrum and orbital sharing obligations with respect to subsequent licensees would be limited to what is technically feasible (or, under the *NPRM* formulation, what is not unreasonably preclusive).

Not only is a bond requirement unnecessary, but it would be administratively burdensome on licensees of Small Commercial Satellites. The legal process and administrative costs of implementing a bond pursuant to the Commission's rules is not insignificant.

Therefore, the Commission should refrain from imposing any bond requirement on Small Commercial Satellite licensees. Instead, the Commission should adopt a build out requirement that voids the license for a Small Commercial Satellite or system if the licensee has not launched at least one of the satellites authorized by the license within three years of the license grant. Such loss of license – along with the loss of the application filing fee[10] and the work that was invested in preparing and prosecuting the application – provides sufficient incentive to compel licensees to launch their authorized satellites as rapidly as possible.

Finally, if the Commission does impose a bond requirement on Small Commercial Satellite licenses, the Commission should adopt a grace period of at least 24 months (instead of the 12 months proposed)[11] before the bond must be posted. Licensees of Small Commercial Satellites should also be able to secure extensions on the 24 month grace period if good cause is shown. A more flexible timeline is necessary because some applicants for small satellites will first secure a Commission authorization for particular frequency bands in order to ensure that such use will be

[10] Boeing concurs with the Commission's proposal to set the application filing fee at $30,000. *See NPRM*, ¶ 76.

[11] *See id.*, ¶ 50.

permitted by the Commission, NTIA, and other primary spectrum users. The satellite operator may then order such long-lead items as radio transmitters and receivers that can operate in the identified frequencies only after securing such approval. The manufacturing time for such specialized radios, combined with spacecraft assembly, testing, and the scheduling of the launch can easily exceed 12 months and, in some cases, will exceed 24 months. Therefore, a longer and more flexible grace period would be appropriate.

V. THE COMMISSION MAY NOT NEED TO ADOPT MANY ADDITIONAL REQUIREMENTS FOR SMALL COMMERCIAL SATELLITES

As long as the Commission adheres to the underlying principle that Small Commercial Satellite licensees must, to the extent technically feasible, share orbital and spectrum resources with all other Small Commercial Satellites, the Commission is unlikely to require many additional regulations governing the characteristics of such satellites. This simplified approach will promote flexibility and technical neutrality in the Commission's rules.

Number of Spacecraft. The Commission's proposal to limit the number of satellites in a Small Commercial Satellite system to a maximum of 10 may be more constraining than necessary.[12] Satellites in very low orbits, such as around 400 kilometers, have visibility to only a small fraction of the Earth's surface. Therefore, a larger number of satellites may be appropriate to reduce the significant gaps in coverage. For example, Boeing suggests a upper limit of 30 satellites (which would match well with the proposed application filing fee of $30,000). Further, the Commission should consider streamlined applications for modestly more numbers of Small Commercial Satellites if good cause is shown to support a particular business case.

[12] *See id.*, ¶ 27.

Frequencies Requested. The *NPRM* suggests the possibility that applicants for Small Commercial Satellites may be restricted regarding the proposed bandwidth of their operational frequencies.[13] Some Small Commercial Satellites are designed to downlink relatively large amounts of data using only one (or very few) earth stations and may require the use of relatively large amounts of bandwidth to complete such data downloads during the brief window in each orbit when it is in view of its earth station. Such techniques are economically and spectrally efficient since they facilitate spectrum sharing. Thus, to enable the use of such techniques, no limits should be imposed on the bandwidth requested by a Small Commercial Satellite applicant.

Planned On-Orbit Lifetime. The *NPRM* proposal that the planned on-orbit lifetime of a Small Commercial Satellite be five years or less (including the time it take for deorbit).[14] Boeing generally supports this proposal. Restricting the mission life and deorbit time of Small Commercial Satellites to just five years will create strong incentives to limit the size and number of Small Commercial Satellites to only what is necessary to accomplish the mission goal.

License Term. A license term of five years would be adequate to cover the period during which the satellite is on-orbit.[15] Such a term, however, would not cover pre-launch ground testing activities. Therefore, in order to avoid forcing Small Commercial Satellite licensees to secure a separate experimental license for ground testing, the Commission should consider authorizing such activities within the framework of a Small Commercial Satellite license, although potentially not as a part of the "Operational Term" of the license.

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[13] *See NPRM*, ¶ 58.

[14] *See id.*, ¶ 28.

[15] *See id.*, ¶ 29.

Boeing also agrees that a Small Commercial Satellite license should not authorize any replacement satellites, or extensions of the Operational Term of the license.[16] Such activities should be conducted under a new Small Commercial Satellite license.

Maximum Spacecraft Size. The Commission should not attempt to impose a limit on the size of a Small Commercial Satellite.[17] The *NPRM* does not suggest a public interest justification for requiring that Small Commercial Satellites refrain from exceeding a particular size or mass. If the concern involves the potential for reentry debris, then this can be addressed as a part of the end-of-life casualty risk assessment.

In any event, licensees of Small Commercial Satellites will have abundant incentives to keep their satellites small and inexpensive, including the obligation to share orbital and spectrum resources with other licensees, the proposed Operational Term limit of five years, and the significant additional costs of launching larger spacecraft into orbit.

Deployment Orbit and Maneuverability. Boeing concurs with the Commission that no restrictions be imposed regarding the maneuverability of Small Commercial Satellites operating below approximately 400 kilometers.[18] At 400 kilometers and above, the Commission should require a demonstration of maneuverability, but it should not require the use of propulsion capabilities to ensure collision avoidance.[19] Other techniques have been used (and more are being developed) to permit small satellites to proactively maneuver without the use of propulsion and thus enable collision avoidance. Boeing disagrees with the conclusion in the *NPRM* that

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[16] *See id.*, ¶ 30.

[17] *See id.*, ¶ 32.

[18] *See id.*, ¶ 33.

[19] *See id.*, ¶ 34.

maneuvering techniques relying "primarily on drag" are "insufficient to support deployment at higher altitudes."[20] The Commission should instead allow applicants for Small Commercial Satellite licenses to provide demonstrations that the techniques that they propose to employ (potentially including drag) are adequate to enable responsive maneuvers. The Commission should also consider proposals to use other techniques and strategies, including operating in elliptical orbits or using inclinations and orbital periods that would avoid conflicts with the International Space Station and similar facilities, in order to make unnecessary the incorporation of maneuvering capabilities in the design of a Small Commercial Satellite.

Operational Debris and Collision Risk. Boeing agrees that the streamlined process for Small Commercial Satellites should only be available for those that release no debris during their operations.[21] Boeing also concurs with the proposals in the *NPRM* regarding limiting the risk of explosions.[22] Consistent with this, the certificate required from an application for a Small Commercial Satellite should address each of the Part 25 requirements regarding fragmentation and accidental explosion, in order to ensure that the applicant has considered them. Finally, Boeing supports the use of the NASA guidance for limiting the risk of collision with large objects to less than 0.001 percent.[23]

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[20] *Id.*

[21] *See id.*, ¶ 35.

[22] *See id.*, ¶ 36.

[23] *See id.*, ¶ 37.

Trackability. Boeing agrees that each Small Commercial Satellite should be capable of being tracked.[24] This could be done either by designing satellites that are large enough for tracking or through other means that the applicant demonstrates will enable tracking.

Casualty Risk. Boeing does not support a requirement that a Debris Assessment Software analysis demonstrate that the risk of human casualty is zero.[25] The current NASA standard is 1:10,000, which should be adequate for Small Commercial Satellites.

Cessation of Emissions. Boeing believes that the Commission should maintain a presumption that a Small Commercial Satellite should be able to immediately cease transmissions upon the receipt of a command from its ground station.[26] The Commission should consider other methods as well that have been approved by the Commission for other wireless communications services. For example, it may be appropriate to permit a Small Commercial Satellite to transmit for no more than 30 seconds at a time and refrain from resuming transmissions thereafter until it receives another affirmative command from its ground station. Although this approach would not allow for the same level of immediacy in the termination of transmissions, this approach would be far more reliable because it would not be contingent on the successful receipt by the satellite of a stop command. Such flexibility will further enhance the flexible and interference free use of Small Commercial Satellites for beneficial commercial purposes.

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[24] *See id.*, ¶ 38.

[25] *See id.*, ¶ 39.

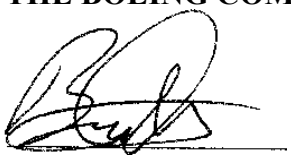
[26] *See id.*, ¶ 40.

VI. CONCLUSION

Small satellites are being employed for an increasing range of experimental and commercial applications. The Commission's experimental licensing process has long facilitated the efficient use of small experimental satellites for numerous productive purposes and such experimental authorizations should continue to be fully available to support non-commercial activities. At the same time, Boeing agrees that it is important for the Commission to promptly adopt a streamlined licensing process for small satellite used for commercial purposes in order to continue to support the growth of the commercial space industry in the United States.

Respectfully submitted,

THE BOEING COMPANY

By: 

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